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REVIEWS

The Guadalupian Fauna. By GEORGE H. GIRTY. Professional Paper 58, U. S. Geological Survey. Pp. 651, 31 plates. 1909.[1]

The appearance of this work, which, according to Dr. Girty, has been in the form of page-proof nearly a year and a half, marks an epoch in the production of fine monographic reports on the upper Paleozoic faunas of America. The subject-matter is no less interesting and important than the quality of the workmanship on the book. It brings to light the most unique and one of the most important faunas known from the American Anthracolitic rocks, and one which must be reckoned with in any broad correlation of horizons above the Mississippian. It represents an immense amount of careful work and painstaking discrimination on the part of the author.

This fauna was first discovered by G. G. Shumard in 1858, and was described by his brother, B. F. Shumard, in 1859. Since that time it has remained unnoticed until the appearance of the present elaborate report, save a couple of preliminary papers by Dr. Girty. All told there are 326 species and varieties. Of these, over 180 forms are defined and illustrated as new, over a hundred undesignated; the remainder are previously described species.

In the introduction the stratigraphy is passed rather briefly; 51 pages are devoted to it and the correlation, the remainder being given to the systematic paleontology.

The stratigraphic relationships of these Permian beds are peculiar and interesting. They are brought to the surface by a westward-facing fault-scarp as it dies out into a fold to the south. Other mountains occur to the west and northwest with older faunas, and only in this one locality is the nearly full section of the Guadalupian rocks shown. The Capitan limestone (white Permian limestone of Shumard) is 1,700 or 1,800 feet in thickness. Below this is the Delaware Mountain formation composed of dark limestones and sandstones with a black limestone 200+ feet thick beneath it, giving, all told, some 2,500 feet to this formation and a total of about 4,000 feet to the whole Guadalupian section as shown at the southern extremity of the mountains. The stratigraphy was largely worked out by Richardson.[1] To the east, on the dipslope of the mountain, the Capitan limestone is wanting. An erosional unconformity is found on the Delaware Mountain formation upon which rests the Castile gypsum. The exposures of the region show 50 or 60 feet of it and a well at Rustler spring penetrated it to a depth of 300 feet. Upon this gypsum lies the Rustler formation consisting of magnesian limestones and sandstone with an average thickness of about 200 feet. To the east, and upon this, lie the Red beds. Richardson's interpretation of the stratigraphic succession is as follows:

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[1] The cover and title-page bear the date 1908. However the book was not distributed until about February, 1909. Ordinarily this close discrimination of dates would be unnecessary, but since something over 180 new species, nine or ten new genera, and three new families of a rather cosmopolitan fauna are named and defined it is important that the date on the title-page should be correct.

> The Castile gypsum along its western outcrop lies on little knolls and valleys of the underlying Delaware Mountain formation, indicating an erosional unconformity. Another evidence of unconformity at the base of the gypsum consists in the absence of the Capitan limestone. It appears that either the gypsum was deposited at or near the top of the Delaware Mountain formation as a lens which did not extend westward to intervene between the Delaware Mountain formation and the Capitan limestone in the Guadalupian Mountains, or that erosion had removed the former southwestward extension of the limestone (the thickness of which is unknown) before the deposition of the gypsum. The former position necessitates the correlation of the Rustler formation, which overlies the gypsum, with the upper part of the Delaware Mountain formation or the Capitan limestone. But there is little to support this interpretation, and it is tentatively assumed that the Castile gypsum and the Rustler formation were formed after the deposition and erosion of a part of the Capitan limestone.[2]

The Red beds approach the Guadalupes closely from the north, and Tarr states that a thousand feet or more of sediments come in on top of the Capitan limestone to the north in New Mexico. Up to the present time the Triassic has not been reported from southern Texas and southern New Mexico, Lee's researches along the Rio Grande in New Mexico and[3] the explorations of the Texas survey having failed, so far, to reveal it. So it would not be at all impossible that the Rustler formation pushes up the dipslope and over the Capitan limestone farther north, and that both lie beneath the upper Red beds. However, it is not certain that this happens, and Dr. Girty's interpretation of the faunas seems to be that such is not the case. Nevertheless the fact that the unconformity exists, that the Capitan limestone is unknown beneath the unconformity lying upon its natural dipslope, and

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[1] *Bull. 9*, Univ. Tex. Min. Surv., 1904.

[2] *Op. cit.*, pp. 43, 44.

[3] *Jour. Geol.*, XV, pp. 52–58, 1907.

Tarr's statement that a thousand feet or so of rocks come in over the white limestone (Capitan) a little farther north in New Mexico, would seem to be indicative of the stratigraphic position of the Guadalupe beds. However, the age of the uppermost beds has not been ascertained. Even though they were Triassic it would seem to leave the Guadalupe beds below the Permo-Triassic unconformity which is known to exist in the Texas Panhandle, northern New Mexico, and Colorado. This would leave a strong possibility of the Capitan limestone being no younger than the Whitehorse beds, or the Quartermaster beds[1] at best.

However, Dr. Girty, who has been over the south end of the Guadalupes passes Tarr's statement—that "the total section exposed in the Guadalupes, approximately stated, cannot be less than 4,000 feet, including the New Mexico series, which exist above the white limestone"—with the remark:

> I do not know what rocks are intended by this indefinite statement. The Capitan limestone is not known in Texas, so far as I am aware, save in the Guadalupe Mountains and the foothills adjacent, where no overlying series is exposed. It must of necessity extend northward into New Mexico, unless faulted out, but all our faunas from New Mexico, so far as I have examined them, show an altogether different facies, one more suggestive of beds which there is every reason to believe lie below the Guadalupian.

The fauna consists of 326 forms: Protozoa, 9; Sponges, 24; Coelenterates, 10; Echinoderms, 7; Vermes, 1; Bryozoa, 44; Brachiopods, 128; Pelecypods, 45; Scaphopods, 1; Amphineura, 1; Gastropods, 42; Cephalopods, 9; Crustaceans, 5. "Aside from the species which Shumard had described, most of the Guadalupian forms appeared to be new." The characteristics of the various classes are briefly mentioned, followed by lists from the various localities and horizons.

The principles which have guided the author in making his determinations are stated as follows:

> It has been said no less truly than often that it is easier to combine two species that have been injudiciously discriminated than to disengage two species that have been injudiciously combined, and it is also true that loose discriminations and loose identifications lead to loose correlations. I have felt under obligations to the workers in this field to leave a species whose relationship I was unable to determine as unentangled as possible, and to establish the nomenclature on a reasonable and permanent basis. Consequently, in doubtful cases I have leaned consciously to the side of species-making, nor would I feel deeply concerned should it prove on just evidence not now accessible to me that some of my names are synonyms.

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[1] See *Kans. Univ. Sci. Bull.*, IV, No. 3, pp. 115–71, 1907.

In accordance with these principles his specific discriminations are very close. This is a thing to be desired provided it is taken into account that mere difference of species is of much less significance than when broader definitions are used. The closer the specific discriminations are drawn the closer the relationship of distinct species may be. This fact should be taken duly into account in making wide correlations of faunas.

In working out these relationships and correlations eight pages are devoted to the enumeration and citation of foreign literature on the Anthracolitic faunas of the world, with brief sentences as to their relationships to the fauna described. About ten pages are devoted to the discussion of the relationships of the Guadalupian, Kansan, and Russian faunas.

With regard to the foreign faunas he states:

> In all these faunas there is none, I regret to say, with which the Guadalupian can really be considered to be closely allied. The nearest are probably the Salt Range and Himalaya, in India, and the Fusulina limestone of Palermo, in Sicily; but in this judgment, in the case of the Indian faunas especially, I may have been too strongly influenced by the occurrence of those two singular brachiopod types, *Richtofenia* and *Leptodus*. The fact is perhaps without special significance, but it may be noted that the occurrences of this faunal facies, or at least the occurrences of these genera, in the three instances mentioned, occupy closely corresponding positions with regard to the earth's equator, and may indicate a zonal development in the late Carboniferous.

Again:

> The resemblances shown by the Guadalupian fauna to even the most similar of those brought into comparison are sporadic and almost immediately offset by differences as great.

It may be that the author has discounted relationships because the species, minutely discriminated, are not identical with those in these very widely separated countries.

Tables, such as those used by Diener in his work on the Himalayan faunas, indicating the distribution of identical and allied species throughout the world and which are so very helpful in epitomizing a work like this, are wanting. The discussion of the relationships of the faunal units is given under the head of the family in which the species or genus occurs, in the systematic part of the work. To collect these scattered discussions and tabulate them so that any general deductions could be drawn from them by the reader is beyond the scope of a review of this kind.

In the discussion of the Kansas and Russian Anthracolitic faunas Dr. Girty states:

> Regarding the correlation of the Kansas "Permian" with the Russian Permian I have not seen any very explicit or satisfactory evidence. The question, it appears

to me, should be considered both in the relation of the Kansas fauna and the Permian fauna as individual and detached entities; in the entire faunal sequence of Kansas to the sequence of the Russian faunas; and, finally, in relation to the collateral evidence which the faunas of other sections bring to the discussion.

The chief arguments which Mr. Prosser has advanced for the correlation seem to be these: The great development of *Fusulina* in the Russian section just below the Permian, paralleled by the development of the same group precedent to the "Permian" of the Kansas section; the development of *Bakewellia* in the Kansas "Permian" and the typical Permian of Russia; and the development in the same beds of the *Pseudomonotis* group of shells. As to *Pseudomonotis*, the genus was introduced in the Kansas section considerably before the "Permian." The abundance with which it occurs at about the horizon of the Kansas "Permian" appears to me a subordinate matter. Again, after critically examining the best specimens of *Bakewellia* which could be obtained, I have been brought to entertain serious doubts as to their generic identity with the *Bakewellias* of the English Permian as represented in King's monograph. The dentition appears to be different and they seem to lack the characteristic series of ligamentary pits.

The statement of the early appearance of *Pseudomonotis* in the Kansas rocks is true, although it had not been noted when Prosser's statement was made in 1895, but it is very remarkable that this fact should be used as an argument against the youth of the higher beds in which it is abundant and characteristic. The same could be said of other Kansas fossils, but I regard it as an indication of the relative youth of the Kansas deposits, rather than their antiquity. Some of the species referred to *Bakewellia* probably belong to Jakowlew's genus *Cyrtodontarca* from the Permo-Carboniferous of southeastern Russia, while the others may be closely related to them. The Coal Measures rocks of the world, so far as I am aware, nowhere exhibit the faunal assemblage of these shells and the associated pelecypods found in these strata in Kansas.

As to the occurrence of the Fusulinas referred to above, it would seem to be the strongest possible evidence in favor of the homotaxy of the deposits. The differences pointed out by Dr. Girty—mentioned later—between the Kansas species and those of Europe are, perhaps, not so important as he supposes. In fact the Fusulinas from many of the Kansas horizons, were sent by St. John to Moeller who carefully studied them and referred them to European species. After studying the Fusulinas from practically all the horizons above the Oread limestone in Kansas the late Dr. Schellwien's letters are decidedly positive, not to say emphatic, on these points and opposed to Dr. Girty's views.

It might also be pointed out that just below the Artinsk a zone in the Russian section is characterized by the profusion of *Schwagerinas* occurring associated with Fusulinas. Now *Schwagerina* has never been reported from the Mississippi Valley, while I have recently offered reason for believing that the Fusulinas of the Kansas section, if they do not belong to a different genus, at least show important differences from the typical Fusulinas. These facts seem to destroy Mr. Prosser's argument so far as this item of evidence is concerned. At the same time these very forms furnish more staple evidence looking somewhat in the same direction.

In his discussion of the Kansas "Permian" Dr. Girty, as he states in another place in the discussion, refers only to the Chase stage, that is, the strata between the Wreford limestone and the Winfield limestone inclusive and the Marion formation.[1] The burden of Dr. Girty's argument, quoted above, and more especially stated by him in other places in the book, is that the Chase stage seems to be of Gschelian age,[2] although he is undecided about it and commits himself to no positive correlation. Since he wrote the statements last quoted, typical Schwagerinas have been found in the Kansas rocks. They were found, not up in the rocks of the Chase stage, but in the Neva limestone a hundred and fifty feet below its base. It is associated with Fusulina of the *longissima* type on the one hand, and, more or less closely, with a micro-foraminiferal fauna of Permo-Carboniferous character on the other. Spandel described, from the same locality and probably from the same stratum, a micro-foraminiferal fauna, mentioned by Dr. Girty, partly of distinctly Coal Measures types and partly of distinctly Permian types.

Following this Dr. Girty points out a long list of Permian fossils of Eurasia which are wanting in the Kansas section, which is interpreted as evidence against the Permian age of the Kansas rocks. Among these are Strophalosia, five species of Productus, etc. Strophalosia is not uncommon in several beds near the base of the Chase stage, 114 specimens of a species of it having been taken from a single layer in a small exposure of the Garrison formation, and altogether about 250 specimens of it have been noted. They are not of the Zechstein type, however, but are of the type, probably, of *S. parva* King, of the English Permian.

It would seem that the general physical conditions prevailing throughout the world at the beginning of and during, Permian time must be taken into account in making broad correlations of Carboniferous and Permian faunas. The significance of the evolution of a provincial fauna in a great epicontinental sea, covering two or three hundred thousand square miles, with inadequate and perhaps only intermittent connection with the open sea of the continental shelves in America, should be as great as the evolution of a fauna in the Urallian region. This significance is increased when it is taken into consideration that both developed during the time when the water was being drawn from the shelves of both continents and the areas of the inland seas were being greatly reduced.

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[1] Almost without exception the Kansas writers have used the term "Permian" in the sense of including the Artinsk, as have almost all paleontologists. Dr. Girty is mistaken in his assumptions to the contrary.

[2] In the use he makes of the term Gschelian he includes the Schwagerina horizon which is wanting in the type locality of the Gschelian and comes in above it in the Ural-Timen region. It is not so included by many European writers. He here takes the opposite stand from what he assumes in refusing to class the Artinskian with the Permian.

In this light the parallelism in the nature of the deposits of the two regions, accompanied by a like parallelism of faunal changes, is of fundamental importance, and deserves a larger consideration than Dr. Girty has given it. For instance, the introduction of new faunal elements, the sudden and nearly complete disappearance of the Fusulina, and the occurrence of Schwagerina bear the same relations to the early gypsum deposits and the development of the Red beds, in the Kansas section, as they do in the eastern part of European Russia. If I read the stratigraphic account of the Guadalupes aright, it seems that the general considerations of the later Permian apply to them likewise. The unconformity, if such it be, carrying away the Capitan limestone from the flanks of the mountain of which it forms the top, and over the unconformity the deposition of the Castile gypsum, Rustler formation, and Red beds strongly suggest that the Guadalupe region was similarly affected with the region to the northward so far as a general Permian emergence is concerned. In this light the Guadalupian faunas must be largely contemporaneous with the Permian faunas of America and Eurasia. In the eyes of the reviewer, judging from figures and descriptions only, there is where their faunal relationships would also place them.

The point is made that the faunas are so different that, if they are contemporaneous with those of the Mississippi valley—of which Dr. Girty seems to be doubtful—they could not both be covered by a single general term [like Permian ?] for their designation. That they are quite distinct from anything yet brought to light on the continent will be granted at once by anyone familiar with the subject. The one is a cosmopolitan, open-sea, coastal-shelf fauna while the other is a more isolated epicontinental sea fauna rather thoroughly separated from its neighbor on the south and perhaps belonging to a different climatic zone. Should they prove to be equivalent in time I see no reason why they might not be covered by a single term of ordinal rank, their local geologic designations being sufficient to differentiate them.

That it was impossible for the Guadalupian and Mississippi valley clearwater faunas to intermingle to a considerable extent after the time represented approximately by the Topeka limestone, unless by a circuitous route, no one acquainted with the geology of the intervening region would hesitate to state.

It is very difficult to determine what Dr. Girty's conclusion as to the relative age of the Guadalupian, Russian, and Kansan deposits is. It is very evident, however, from the bulk of his reasoning, that he considers both of the former younger than the Kansan deposits. It is also to be remembered that the book was written, and perhaps in type, before the later Kansas studies were published. He was also handicapped by the fact that he was without a personal field knowledge of the Kansas Permian deposits, and for this reason fails fully to appreciate the changed aspect of the fauna, noted by all the paleontologists who have studied the region, from Meek to Prosser.

J. W. BEEDE

A Key for the Determination of Rock-forming Minerals in Thin Sections. BY ALBERT JOHANNSEN, PH.D. New York: John Wiley & Sons.

This work contains about 540 pages of text and tables conveniently arranged for laboratory use. It is much more than a key, for all of the most useful optical methods are described in a concise manner, which will be appreciated by anyone who is engaged in the microscopic study of rock sections. It will be especially helpful to the geologist who uses petrology as an aid to the study of problems of general or economic geology and who finds it necessary to review his optics each year at the beginning of the period of office work.

The arrangement of the tables is original and excellent. The first page of the table for each group is a diagram showing the birefringence, double refraction, and optical character of each numeral of the group. The color plate or table of birefringences in the back of the book is large enough to be useful and not too large to be handled conveniently. There is hardly a diagram or a table which is used by petrographers in everyday practice which is not given in the *Key* and the whole arrangement is designed to gain accuracy and save time.

W. H. E.

Synopsis of Mineral Characters. BY RALPH W. RICHARDS. New York: John Wiley & Sons.

In this useful work of 100 pages the most important minerals are arranged alphabetically and their chief chemical and physical character-